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Patent
Attorney Docket No. GEMS8081.152

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of : Foo et al.
Serial No. : 09/682,685
Filed : October 5, 2001
For : Efficient Multi-Slice Acquisition With Black Blood
Contrast In Fast Spin Echo Imaging
Group Art No. : 3737
Examiner : Smith, R.

CERTIFICATION UNDER 37 CFR 1.8(a) and 1.10

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RESPONSE TO ORDER RETURNING UNDOCKETED APPEAL

Dear Sir:

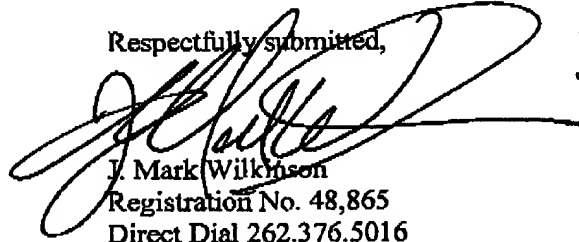
Responsive to the Order Returning Undocketed Appeal, Appellant has enclosed herewith a Supplemental Appeal Brief Pursuant to 37 C.F.R. §§1.191 and 1.192. Appellant has also enclosed a courtesy copy of the above referenced Order.

Additionally, Appellant requests the Examiner's assistance with regard to a corrected filing receipt for the above-captioned matter. Numerous requests have been

made seeking a corrected filing receipt, but, to date, no such filing receipt has been received. It is also noted that the appellants listed in the enclosed Order do not properly reflect the inventors of this matter as provided in the Requests to Correct Inventorship filed March 10, 2003 and April 4, 2003.

Appellant cordially invites the Examiner to contact the undersigned with any questions regarding this matter.

Respectfully submitted,



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Dated: November 29, 2005
Attorney Docket No.: GEMS8081.152

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The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

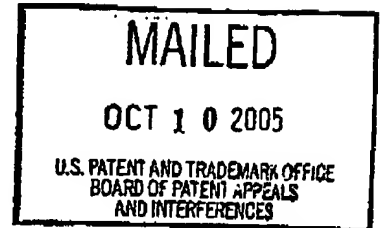
UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte TIN-SU PAN,
STEVE WOLOSCHKE and H. DAVID HE

Application No. 09/682,685

ORDER RETURNING UNDOCKETED APPEAL



This application was received at the Board of Patent Appeals and Interferences on June 21, 2005. A review of the application has revealed that the application is not ready for docketing as an appeal. Accordingly, the application is herewith being returned to the Examiner. The matters requiring attention prior to docketing are identified below.

APPEAL BRIEF

Further, the file indicates that on October 28, 2004, appellants filed an Appeal Brief under the rules set forth in 37 CFR § 1.192(c). However, the rules under 35 U.S.C. § 1.192(c) were abolished on September 13, 2004, and replaced by 37 CFR § 41.37(c). Accordingly, the Appeal Brief filed on October 28, 2004, does not comply with the new rules under 37 CFR § 41.37(c).

-1-

Docketed by: DAE
Date: 11-15-05

Application No. 09/682,685

which states:

(c)(1) The brief shall contain the following items under appropriate headings and in the order indicated in paragraphs (c)(1)(I) through (c)(1)(x) of this section, except that a brief filed by an appellant who is not represented by a registered practitioner need only substantially comply with paragraphs (c)(1)(i) through (c)(1)(iv) and (c)(1)(vii) through (c)(1)(x) of this section.

A review of the appellant's Appeal Brief reveals that the following required appendices are missing:

37 CFR § 41.37(c)(1)(ix), which is identified in the new rules as:

(ix) *Evidence appendix*. An appendix containing copies of any evidence submitted pursuant to §§ 1.130, 1.131, 1.132 of this title or of any other evidence entered by the examiner and relied upon by appellant in the appeal, along with a statement setting forth where in the record that evidence was entered in the record by the examiner. Reference to unentered evidence is not permitted in the brief. See § 41.33 for treatment of evidence submitted after appeal. This appendix may also include copies of the evidence relied upon by the examiner as to grounds of rejection to be reviewed on appeal.

and

37 CFR § 41.37(c)(1)(x), which is identified in the new rules as:

(x) *Related proceedings appendix*. An appendix containing copies of decisions rendered by a court or the Board in any proceeding identified pursuant to paragraph (c)(1)(ii) of this section.

(2) A brief shall not include any new or non-admitted amendment, or any new or non-admitted affidavit or other evidence. See § 1.116 of this title for amendments, affidavits or other evidence filed after final action but before or with any appeal and § 41.33 for amendments, affidavits or other evidence filed after the date of the appeal.

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Section 37 CFR § 41.37(c) further states:

(d) If a brief is filed which does not comply with all the requirements of paragraph (c) of this section, appellant will be notified of the reasons for non-compliance and given a time period within which to file an amended brief. If appellant does not file an amended brief within the set time period, or files an amended brief which does not overcome all the reasons for non-compliance stated in the notification, the appeal will stand dismissed.

It is required that a substitute Appeal Brief be submitted that is in compliance with 37 CFR § 41.37(c). For more information on the Board's new rules, please see the web page entitled "More Information on the Rules of Practice Before the BPAL," Final Rule at:

<http://www.uspto.gov/web/offices/dcom/bpai/fr2004/moreinfo.html>.

CONCLUSION

Accordingly, it is

ORDERED that the application is returned to the examiner for:

- 1) hold the Appeal Brief filed on October 28, 2004, defective;
- 2) to notify appellants to file a substitute Appeal Brief in compliance with 37 CFR

§ 41.37;

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- 3) consider the substitute Appeal Brief and prepare a revised Examiner's Answer; and
- 4) for any further action as deemed appropriate.

BOARD OF PATENT APPEALS
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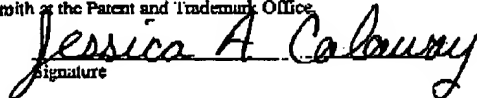
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SUPPLEMENTAL APPEAL BRIEF PURSUANT TO 37 C.F.R. §§1.191 AND 1.192

Dear Sir:

This Supplemental Appeal Brief is being filed in furtherance to the Order Returning Undocketed Appeal mailed October 10, 2005.

1. **REAL PARTY IN INTEREST**

The real parties in interest are General Electric Company and GE Medical Systems Global Technology Company, LLC, an Assignee of the above-referenced application by virtue of the Assignment to GE Medical Systems Global Technology Company, LLC, recorded on August 7, 2003, at reel 13855, frame 0812, and Mount Sinai Medical Center by

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virtue of the Assignment to Mount Sinai Medical Center recorded on August 7, 2003, at reel 013855, and frame 0816.

2. **RELATED APPEALS AND INTERFERENCES**

Appellant is unaware of any other appeals or interferences related to this Appeal. The undersigned is Appellant's legal representative in this Appeal. GE Medical Systems Global Technology Company, LLC, and Mount Sinai Medical Center, the Assignees of the above-referenced application, as evidenced by the documents mentioned above, will be directly affected by the Board's decision in the pending appeal.

3. **STATUS OF THE CLAIMS**

Claims 1-29 are currently pending, claims 1-20 have been allowed, and claims 21-29 are currently under final rejection and, thus, are the subject of this appeal.

4. **STATUS OF AMENDMENTS**

No Amendments have been made since the final Office Action mailed May 3, 2004.

5. **SUMMARY OF THE INVENTION AND OF THE DISCLOSED EMBODIMENTS**

The present invention relates to an MR pulse sequence, apparatus, and a technique for efficient multi-slice acquisition with black blood contrast in fast spin echo imaging. See Application, pg. 3.

The proposed technique includes a non-selective inversion RF pulse, followed by a broad-band slice selective pulse that re-inverts the spins in the slab encompassing the slices to be imaged. After an inversion time, RF excitation pulses with a fast spin echo readout are executed acquiring data for each spatial slice in an order that provides optimal blood suppression. The inversion time is preferably selected such that the blood signal is close to the null point. This technique differs from conventional gated fast spin echo imaging with black blood image contrast in that the re-inversion or tip-up pulse in the conventional technique is effective only in a single slice of interest which results in only one slice or spatial section acquired per breath-hold or acquisition. The present invention allows for multi-slice acquisition. See Application, pg. 3.

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A method of multi-slice fast spin echo image acquisition with black blood contrast is disclosed that includes a non-selective inversion pulse and applying a re-inversion pulse that is slice selective over a region encompassing a plurality of slice selections. The method includes timing execution of the series of RF excitation pulses with fast spin echo readout such that signal from black blood is near a null point. Data is then acquired for each spatial slice. See Application, pg. 3.

A computer program is disclosed for multi-slice coverage in a single acquisition with black blood T_2 -weighted image contrast. The computer program has a set of instructions that when executed by a computer cause a computer to generate and cause application of a non-selective inversion RF pulse to a slab of slices, each having a predefined thickness. The computer program also causes the computer to generate and cause application of a slice selective re-inversion RF pulse having a slice thickness greater than the predefined thickness of a single slice and apply an inversion time so that a null point of blood within the slab occurs in a middle of an acquisition. A series of RF excitation pulses is applied and MR data is acquired for each slice in the slab. See Application, pgs. 3-4.

An MR apparatus to produce consistent contrast in FSE image acquisition is disclosed. The apparatus includes an MRI system having a number of gradient coils positioned about a bore of a magnet to impress a polarizing magnetic field and an RF transceiver system and an RF modulator controlled by a pulse control module to transmit RF signals to an RF coil assembly to acquire MR images. The MRI apparatus also includes a computer programmed to apply a pulse sequence having a non-selective inversion pulse to invert spins in a longitudinal direction across an entire slab of slices and a slice selective re-inversion pulse having an implied width at least as large as that of the non-selective inversion pulse. The pulse sequence applied by the computer also has a series of excitation pulses having fast spin echo readout spaced apart from the slice selective re-inversion pulse by an inversion time to acquire data for each slice in the slab. See Application, pg. 4.

A pulse sequence for use in multi-slice MR data acquisition is disclosed. The pulse sequence includes a non-selective inversion pulse applicable to a slab of slices and a slice selective re-inversion pulse applicable to at least a number of the slices in the slab of slices. The pulse sequence also includes a series of fast spin echo readout excitation pulses applicable to the at least a number of slices in the slab of slices after an inversion time. Preferably, the aforementioned inversion time is selected so that blood in the slab is at or near the null point. See Application, pgs. 4-5.

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6. **GROUND S OF REJECTION**

Claims 21-29 stand rejected under 35 U.S.C. §101 as being directed to non-statutory subject matter.

7. **REJECTION UNDER 35 U.S.C. §101**

As discussed in detail below, the Examiner has improperly rejected claims 21-29. The Examiner finally rejected claims 21-29 and stated that “[a] pulse sequence is considered to be a type of signal which does not encompass any of the statutory categories of invention.” Office Action, pg. 2 (May 3, 2004). The Examiner further asserted that “[t]he claims are not directed to a practical application” and that “[t]he claims fail to positively set forth any means for producing the pulses or means for acquiring MR data after the pulses have been applied to a patient’s body.” *Id.* The Examiner then concluded that “the claims merely set forth a series of pulses of electromagnetic radiation with intended use that they be directed to a slab of slices in the patient’s body.” *Id.*

Contrary to the Examiner’s conclusions, Appellant respectfully disagrees that claims 21-29 are directed to non-statutory subject matter. It is generally recognized that “anything under the sun that is made by man” may be patentable with three notable exceptions: abstract ideas, laws of nature, and natural phenomena. See MPEP §2106.IV.A. “These three exclusions recognize that subject matter that is not a practical application or use of an idea, a law of nature or a natural phenomenon is not patentable.” *Id.* In short, a claim directed to the practical use of natural phenomenon is patentable, but the natural phenomenon itself is not.

The Examiner has asserted that the subject matter of claims 21-29 is directed to a non-practical application of magnetism. See Office Action, supra, at 2. The Examiner’s assertions illustrate that the Examiner has failed to appreciate that which is claimed. As recognized in the art and admitted by the Examiner, a “pulse sequence” is characterized as a series of RF pulses and/or magnetic field gradients applied to a spin system to produce a signal representative of some property of the spin system. Claim 21 calls for a “pulse sequence” comprising a non-selective inversion pulse, a slice-selective re-inversion pulse, and a series of excitation pulses that are played out for multi-slice MR data acquisition. While the principles of RF energy and magnetism are employed to achieve the multi-slice MR data acquisition, Appellant has not claimed principles, but has claimed a pulse sequence,

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as defined by the claim limitations, which is directed to more than just RF energy and magnetism. The pulse sequence is signals defined by an ordered application of RF and magnetic energy to achieve the practical end of multi-slice MR data acquisition. Moreover, there is no evidence that this ordered application occurs naturally. Moreover, one skilled in the art of MR imaging would acknowledge that it is the practical application of RF and magnetic energy that makes MR imaging viable.

Appellant believes an example will further illustrate this point. Fallen sticks of wood from a tree are a naturally occurring product of nature. It is well recognized, however, that arranging sticks of wood into a chair is a practical application of the wood that makes the chair patentable subject matter. The same analysis can be applied to that called for in claims 21-29. RF energy and magnetism are naturally phenomena; however, it is their application in a non-naturally occurring order to acquire MR data that illustrates one example of their practicality.

Additionally, the Examiner acknowledged that "[a] pulse sequence is considered to be a type of signal..." Office Action, supra, at 2. MPEP §2106.IV.B.1(c) states that:

[A] signal claim directed to a practical application of electromagnetic energy is statutory regardless of its transitory nature. See O'Reilly, 56 U.S. at 114-19; In re Breslow, 616 F.2d 516, 519-21, 205 USPQ 221, 225-26 (CCPA 1980). MPEP §2106.IV.B.1(c).

The Examiner also has admitted the practical application of the signal in stating that "the claims merely set forth a series of pulse of electromagnetic radiation with intended use that they be directed to a slab of slices in the patient's body". Office Action, supra at pg. 2.

As set forth above, the subject matter of claims 21-29 is directed to the application of electromagnetic energy to multi-slice acquisition of MR data. Therefore, given the Examiner's own admission that the "pulse sequence is considered to be a type of signal" and the application of that "signal" to the practical and useful end of MR data acquisition, the Examiner's rejection under 35 U.S.C. §101 cannot be sustained and, thus, should be withdrawn.

8. CONCLUSION

Although magnetism and RF emissions are naturally occurring phenomena and are thus not patentable in the abstract, in MR imaging, these phenomena are manipulated and

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exploited to acquire MR data. It is the generation and manipulation of magnetic fields and RF signals through a pulse sequence that characterizes the use of these phenomena to a new and useful end. In this regard, a "pulse sequence" defines the manner in which these naturally occurring phenomena are to be exploited to reach a new and useful end, namely, "multi-slice MR data acquisition."

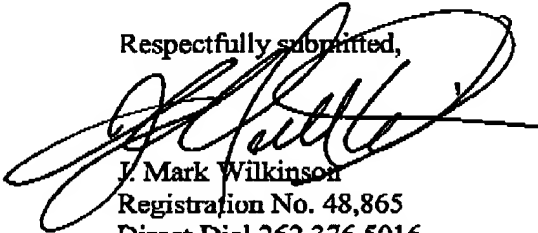
Since claims 21-29 are directed to a sequence of specific and uniquely tailored pulses that have practicality in MR data acquisition, Appellant respectfully submits that the Examiner has provided no supportable position or evidence that claims 21-29 are directed to non-statutory subject matter.

Incidentally, USP 6,498,946, from which the present application claims priority, also has "pulse sequence" claims. Appellant respectfully requests that the Board direct withdrawal of all outstanding rejections and direct the present application be passed to issuance.

General Authorization for Extension of Time

In accordance with 37 C.F.R. §1.136, Appellant hereby provides a general authorization to treat this and any future reply requiring an extension of time as incorporating a request therefore.

Respectfully submitted,



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Dated: November 29, 2005
Attorney Docket No.: GEMS8081.152

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CLAIMS ON APPEAL APPENDIX

1. (Allowed) A method of multi-slice image acquisition with black-blood contrast comprising:

applying a non-selective inversion pulse;
applying a re-inversion pulse that is slice-selective over a region encompassing a plurality of slice selections;
timing execution of a series of RF excitation pulses such that signal from blood is near a null point; and
acquiring data for the plurality of slice selections.

2. (Allowed) The method of claim 1 wherein the plurality of slice selections include all slice selections in a slab to be imaged.

3. (Allowed) The method of claim 1 wherein the images are acquired over more than a single breath-hold.

4. (Allowed) The method of claim 1 wherein the re-inversion pulse is applied over a region having all slice selections in a slab and data are acquired for all slice selections in the slab using a single re-inversion pulse.

5. (Allowed) The method of claim 1 further comprising creating the inversion pulse with slice thickness given by:

$$\text{slice thickness} = (Z_1 - Z_n) + 4 * \text{opslthick},$$

where Z_1 and Z_n represents spatial locations of first and last slices selected for imaging, and opslthick represents a desired imaging slice thickness.

6. (Allowed) The method of claim 5 further comprising creating the re-inversion pulse with a center centered about a midpoint between Z_1 and Z_n .

7. (Allowed) The method of claim 1 wherein the timing step includes selecting an inversion time TI such that the null point of the blood occurs near a center of the multi-slice acquisition.

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8. (Allowed) The method of claim 1 further comprising modifying a flip angle of RF excitation pulses executed before and after an occurrence of the null point of the blood to improve blood suppression.

9. (Allowed) The method of claim 8 further comprising modifying the flip of RF excitation pulses occurring before the null point to slightly less than 90° and those occurring after the null point to slightly more than 90° .

10. (Allowed) A computer program stored on a computer readable storage medium and having a set of instructions that when executed by a computer cause the computer to:

(A) generate and cause application of a non-selective inversion RF pulse to a slab of slices each having a thickness;

(B) generate and cause application of a slice-selective re-inversion RF pulse having a slice thickness greater than the thickness of a single slice;

(C) apply an inversion time;

(D) apply RF excitations; and

(E) acquire MR data.

11. (Allowed) The computer program of claim 10 wherein the slice thickness of the re-inversion pulse is selected greater than the slab of slices to allow for cardiac motion between the application of the slice-selective re-inversion RF pulse, and the acquisition of MR data.

12. (Allowed) The computer program of claim 10 wherein the RF excitations have a flip angle greater than 90° for segments after a null point and less than 90° for segments before the null point.

13. (Allowed) The computer program of claim 10 wherein acts (A) – (E) are carried out over one or more R-R intervals.

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14. (Allowed) The computer program of claim 10 wherein the MR data is acquired during mid-diastole of an R-R interval.

15. (Allowed) An MR apparatus to produce consistent contrast in image acquisition comprising:

a magnetic resonance imaging (MRI) system having a plurality of gradient coils positioned about a bore of a magnet to impress a polarizing magnetic field and an RF transceiver system and an RF switch controlled by a pulse module to transmit RF signals to an RF coil assembly to acquire MR images; and

a computer programmed to apply a pulse sequence having:

a non-selective inversion pulse to invert spins in a longitudinal direction across an entire slab of slices;

a slice-selective re-inversion pulse having an implied width at least as large as that of the non-selective inversion pulse; and

a series of excitation pulses spaced apart from the slice-selective re-inversion pulse by an inversion time.

16. (Allowed) The MR apparatus of claim 15 wherein the slice-selective re-inversion pulse of the pulse sequence is further defined as having a width greater than that of the non-selective inversion pulse to extend on either side of the non-selective inversion pulse.

17. (Allowed) The MR apparatus of claim 16 wherein the slice-selective re-inversion pulse extends approximately twice the nominal slice thickness on either side of the non-selective inversion pulse.

18. (Allowed) The MR apparatus of claim 15 wherein the inversion time of the pulse sequence is selected such that blood signal is close to a null point.

19. (Allowed) The MR apparatus of claim 18 wherein the series of excitation pulses have therein excitation pulses with differing flip angles.

20. (Allowed) The MR apparatus of claim 19 wherein excitation pulses occurring near a mid-point of the series have a flip angle near 90° and excitation pulses

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occurring before a mid-point have a flip angle less than 90° and excitation pulses occurring after the mid-point have a flip angle more than 90° .

21. (On Appeal) A pulse sequence for use in multi-slice MR data acquisition comprising:

- a non-selective inversion pulse applicable to a slab of slices;
- a slice-selective re-inversion pulse applicable to at least a number of slices in the slab of slices; and
- a series of excitation pulses applicable to the at least a number of slices in the slab of slices after an inversion time.

22. (On Appeal) The pulse sequence of claim 21 wherein the inversion time is selected to allow signal from blood in a mid-point of the at least a number of slices to approach a null point.

23. (On Appeal) The pulse sequence of claim 21 wherein the at least a number of slices includes all slices in the slab of slices.

24. (On Appeal) The pulse sequence of claim 21 wherein the at least a number of slices includes fewer slices than those in the slab of slices but more than one.

25. (On Appeal) The pulse sequence of claim 21 wherein the at least a number of slices includes more slices than those in the slab of slices.

26. (On Appeal) The pulse sequence of claim 21 wherein the non-selective inversion pulse has a thickness given by:

$$\text{slice thickness} = (Z_1 - Z_n) + 4 * \text{opslthick},$$

where Z_1 and Z_n represents spatial locations of first and last slices selected for imaging, and opslthick represents a desired imaging slice thickness.

27. (On Appeal) The pulse sequence of claim 26 wherein the slice-selective re-inversion pulse has a center centered about a mid-point between Z_1 and Z_n .

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28. (On Appeal) The pulse sequence of claim 21 wherein the series of excitation pulses have varying flip angles.

29. (On Appeal) The pulse sequence of claim 28 wherein excitation pulses that occur before a mid-point of the series have a flip angle of less than 90° , those near the mid-point have a flip angle near or at 90° , and those that occur after the mid-point have a flip angle greater than 90° .

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EVIDENCE APPENDIX

-- None

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RELATED PROCEEDINGS APPENDIX

-- None